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## THE SCIENTIFIC AND ADMINISTRATIVE ACHIEVEMENT OF THE MEDICAL CORPS OF THE UNITED STATES ARMY

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WHEN the history of the present European war comes to be written, it will be found that the part played in the great world struggle by the medical officers of the different armies engaged has been in every way as important as the achievements of the line. Not only has the mortality of the army surgeons in the different battles been fully as high as that of the infantry, but the military administrators have been compelled to admit, reluctantly in some cases, that the medical profession has been their mainstay in the matter of evacuating the wounded from the battlefields and in sending a majority of the wounded back to field service in an incredibly short space of time. In the past, the status of the army surgeon was as dubious as that of the rest of his professional brethren. In seventeenth and eighteenth century Prussia, he was still a barber surgeon who shaved the officers of the line, and only a few years ago, a British medical officer who had been rewarded for heroism in the field was contemptuously dubbed "a brave civilian" by the commander of the British army, a man who never saw a battle. Modern wars have changed all that. The commanding officer of to-day, who is wise, instinctively acts according to the sentiment of General Winfield Scott: "I am in the habit, myself, when on duty with troops, of paying great deference, and even of yielding my opinion, on matters deeply affecting health and life, to the advice of my medical staff." "War," said the Russian army surgeon Pirogoff, "is a traumatic epidemic. Not medicine, but administration plays the leading part in the aid of the sick and wounded in the scenes of war." The work of Pasteur and Lister has made the first part of this aphorism negligible. Thanks to antiseptic surgery, we no longer fear the traumatic infectious diseases in the field or base hospitals. But the second part of Pirogoff's dictum reveals the wonderful prescience of the gifted Russian. Medicine is now slowly coming into its own. The army medical officer of to-day must not only be a trained scientist but a capable administrator. In other words, his duties in the zone of advance, the line of communications, and the interior, are in every respect as onerous and exacting as those of the line or engineer officer, and the story of his accomplishment, in the present war, will, when told, make a brilliant record. At the present moment, it seems fitting and proper

to draw public attention to the scientific and administrative achievement of the Medical Corps of our Army in the past. In preparing this record, I have been much indebted to Dr. Fielding H. Garrison (Surgeon General's Library), who has summarized the recent work of the Medical Department of the Army in his "History of Medicine" (1913, 1917).<sup>1</sup>

During the colonial period, the status of medicine on this continent was of the most provincial character, its practitioners being sometimes ministers of the Gospel, oftener men who had got their training with physicians under indentures of apprenticeship, with no medical degree whatever, self-trained mid-wives for obstetric cases, back-woods saw-bones who had acquired their knowledge of surgery in the most rough and ready fashion, and a few settlers who had acquired a legitimate education in Europe, with the still more favored few whose parents were able to give their sons a proper medical education at some European university. The title "doctor" was not even employed in the Colonies before 1769. Medical legislation in the several states was mainly centered upon the regulation of physicians' fees, and with the exception of the Acts of Massachusetts in 1649 and 1699, and of New York in 1665, little of it was restrictive, in the sense of excluding the incompetent, or of application to the prevention of infectious diseases.<sup>2</sup>

With the Revolutionary War, which has been described as "the making of medicine in this country," things took a new turn. Morgan, Shippen and Rush, the three Surgeons General who did most for the medical service of the Army in this War, were also the three greatest American physicians of the period. John Morgan (1735-89), who was appointed Director General and Physician in Chief of the American Army in 1775, and William Shippen (1736-1808), who succeeded him in 1777, were the leading pioneers in advancing medical education in this country, having collaborated as founders of the Medical Department of the University of Pennsylvania in 1765. Benjamin Rush (1736-1808), who was appointed Surgeon General of the Hospital in the Middle Department in 1777, transferring to the position of Physician General twelve weeks later, was regarded, both in Europe and America, as the greatest American physician of the period, being somewhat effusively styled the American Sydenham and the Hippocrates of Pennsylvania. Although he deserted Washington at Valley Forge to join the "Conway Cabal," Rush was the author of a valuable pamphlet on the hygiene of troops (1777), the first American treatise on insanity (1812), and the first contributions made in this country to the then unknown science of anthropology (1774-88). He was perhaps the first physician to describe cholera infantum (1773), the second to describe dengue (1780), and the part he played in fighting the epidemic

<sup>1</sup> Garrison, "Introduction to the History of Medicine," Philadelphia, 1913, 618-620; 2d ed., 1917, 732-736.

<sup>2</sup> *Ibid.*, 2d ed., 1917, 296-298.

of yellow fever in Philadelphia in 1793 is a prominent feature of the history of that city.

The earliest American pharmacopœia to be printed was that prepared for the use of the Continental Army by Dr. William Brown, of Virginia, who succeeded Rush as Physician-General of the Middle Department (1778-80). It was issued from the military hospital at Lititz, Lancaster County, Pa., and appeared anonymously as a Latin booklet of thirty-two pages in 1778. A facsimile of the title-page of the second edition (1781), which bears the name of Brown, may be seen in Dr. Henderson's translation of Baas's "History of Medicine" (p. 820). A unique copy of the rare first edition is on exhibition in the Surgeon General's Library.

James Thacher (1754-1844), who became Assistant Surgeon in 1775, left a remarkable "Military Journal during the American Revolutionary War" (1826), which is an authoritative source of historical information, describing the treason of Arnold, and the capture of André, and giving perhaps the best contemporary appreciation of the character of Washington. Thacher was also the author of the first American work on medical biography (1828), which makes him, in a sense, our first medical historian.<sup>3</sup>

John Jones (1729-91), who had been a surgeon of French troops in the war of 1758 and afterwards rendered worthy service in the Revolution, published a treatise on wounds and fractures in 1775, which was the first surgical work published in this country, and, through its appendix on camp and military hospitals, the first American book on military medicine.

Of the early Surgeons General after the Revolution, James Tilton (1745-1822) introduced the "hut system" during the war, to avoid overcrowding of hospitals, and also published the first American book on medico-military administration (1812). Joseph Lovell (1788-1836), appointed Surgeon General upon the formal organization of the Army Medical Department in 1818, organized the Department and revised its regulations, giving it the form which it retained up to 1861. In 1834, he introduced competitive examinations for admission to the Corps and he abolished the whiskey ration. Thomas Lawson (1795-1861), Surgeon General from 1836 until the outbreak of the Civil War, secured actual military rank without command for the Army Medical Officers in 1847, and, in 1856, enlarged the capacity of his commissioned force by the enlistment of hospital stewards as such.

William Alexander Hammond (1828-1900), Surgeon General during 1862-64, early made his mark as a physiologist by his essay on "The Nutritive Value and Physiological Effects of Albumin, Starch

<sup>3</sup> The first American book on the history of medicine was actually a work of the colonial period, viz., Peter Middleton's "A Medical Discourse, or an Historical Inquiry into the Ancient and Present State of Medicine," New York, 1769.

and Gum when singly and exclusively used as Foods" (1857), which was awarded the prize of the American Medical Association in 1857, gave him a European reputation and secured him the Chair of Anatomy and Physiology in the University of Maryland in 1860. During his war service as Surgeon General, he introduced many reforms and improvements in the medical service, such as the issue of a new and enlarged supply table, the furnishing of suitable hospital clothing to patients, the establishment of a new and complete system of hospital reports, the reorganization of examinations and examining boards for the medical service, and the extensive construction of hospitals built upon the pavilion system. Of Hammond's career as Surgeon General Dr. Weir Mitchell said:

Whatever else may be thought or said of William A. Hammond, nothing is more sure to me than that he duly saw and grasped a great opportunity; that he served his country as few could have done; that he created the Army Medical Museum; that he saw the need for and advised the creation of the Army Medical School; that he pointed out the men who were to direct the Army Museum and the Army Library. Until the end of his Army career he was the unfailing friend of scientific study, and created special hospitals for diseases of the heart, lungs and neural maladies.

At these hospitals, Acting Assistant Surgeon J. M. Da Costa first described irritable heart in soldiers (1862), and Acting Assistant Surgeons S. Weir Mitchell, George R. Morehouse and William W. Keen made their investigations of gun shot and other injuries of nerves (1864), which have since become classical. Hammond's systematization of medico-military reports led to the "Medical and Surgical History of the War of the Rebellion" (1870-88), which was completed under his administrative successors, Joseph K. Barnes (1864-82), Charles H. Crane (1882-3), Robert Murray (1883-6) and John Moore (1886-90), by Surgeons George A. Otis, Joseph Janvier Woodward, Charles Smart and David L. Huntington. This is a great collection of surgical and medical case histories and pathological reports, in six huge quarto volumes, embellished with splendid plates, a work which soon became known all over the civilized world as the most remarkable contribution to military medicine made up to that time. It received the highest praise from Professor Rudolph Virchow, the greatest of modern pathologists. After his dismissal from the Army, in consequence of his difficulties with Secretary Stanton, Hammond went to New York, where he became a noted authority on nervous diseases and insanity, through his treatises on these subjects, published in 1871 and 1883 respectively. He was the first to describe the neurotic condition known as "athetosis" (1873), and was editor of the *Quarterly Journal of Physiological Medicine and Medical Jurisprudence* (1867-72), the *New York Medical Journal* (1867-9), and the founder and editor of the *Journal of Nervous and Mental Disease* (1867-83).

To Hammond's successor, Joseph K. Barnes (1817-83), Surgeon General during 1864-82, fell the task of disbanding the huge corps of civil physicians serving the army under contract, dismantling and discontinuing the great hospitals, settling outstanding accounts and non-continuing appropriations, which was carried forward under the direction of his able assistant, Surgeon J. S. Billings. Under Barnes, the exclusive control of general hospitals and hospital camps was vested in the Medical Department, the publication of the Medical and Surgical History of the War was begun, the development of the Army Medical Museum and Library was fostered under the direction of Billings, and the exhaustive Reports upon Barracks and Quarters and Hygiene of the Army, edited by Billings, were published in 1870 and 1875 respectively. Next to the Medical and Surgical History of the War, these were the most important contributions made to military medicine in this period.

Under John Moore (1826-1907), Surgeon General during 1886-90, instruction in first aid was inaugurated in the service in 1886. This was one of the most important steps for the welfare of troops, in connection with which the first aid books of Dietz, Smart and Pilcher were published and the Hospital Corps of the United States Army was organized by Act of Congress in 1887, resulting in the drill manuals of Pilcher, Heizmann, Hoff, Havard, Woodhull and Dietz. The last volume of the Medical and Surgical History of the War was published in 1888.

Charles Sutherland (1831-95), Surgeon General during 1890-93, gave the Medical Department a new field equipment, gave the post hospitals sole authority for the issuance of surgical supplies and furthered the development of the Hospital Corps.

George Miller Sternberg (1838-1915), Surgeon General 1893-1902, was the first to isolate the bacillus of croupous pneumonia (1880), published the first manual (1893) and text-book (1896) of bacteriology, and important treatises on immunity (1895), disinfection (1900) and infection (1903). He did important scientific work on yellow fever, and, under his administration, the agent of transmission of yellow fever was discovered by Major Walter Reed in 1901, and the sanitary regeneration of Havana was accomplished by Major William C. Gorgas, shortly after. During the Spanish-American War, General Sternberg met all the increased demands upon his corps with efficiency, in the face of legislative embarrassment and administrative obstacles, establishing a corps of female nurses for service in permanent hospitals, increasing the medical staff by officers selected from the Association of Military Surgeons, and afterwards supervising the organization of medical service in our new tropical possessions. He founded the Army Medical School, established laboratories of bacteriology and hygiene in connection with the Army Medical Museum, secured the assignment of medical

officers to stations in large cities affording unusual advantages for advanced medical studies, established a sanatorium at Fort Bayard for the treatment of pulmonary tuberculosis, created a special surgical hospital at Washington Barracks, and organized additional schools for the Hospital Corps.

Robert Maitland O'Reilly (1845-1912), Surgeon General during 1902-9, was an active member of boards for selecting camp sites during the Spanish-American War and the cleaning up of Havana after it. Upon assuming the office of Surgeon General, he immediately set himself to the task of carrying out the recommendations made by the Dodge Commission for the improvement of the Army Medical Corps, as the result of which it is now able to equip its hospitals and field units more rapidly than they can be organized and their personnel brought together. He created the Medical Reserve Corps of the Army for the expansion of its medical service in time of war, in which many distinguished physicians and surgeons of the country are now enrolled. He organized and presided over the Board recommending the adoption of preventive vaccination against typhoid fever in the army, and it was due to his good offices that Professor Russell H. Chittenden, of Yale University, was able to use a squad of Hospital Corps men in carrying out his important experiments upon the physiological economy of nutrition, the practical object in view being to ascertain the best scheme of rations for troops under modern conditions.

George H. Torney (1850-1913), Surgeon General during 1909-1913, instituted compulsory vaccination against typhoid fever among United States troops, also the measures for the control of venereal diseases in the Army and of beri beri in the Philippines. All these have been most effective. During the mobilization of United States troops on the Mexican border in 1912, Major Frederick F. Russell vaccinated the entire body, some 20,000 men, against typhoid fever, and by further vaccinations throughout the army has brought down the morbidity and mortality record of this disease to practically zero. Beri beri has practically disappeared among the rice eating native troops in the Philippine Islands, largely through the investigations of Captain Edward B. Vedder. At the outbreak of the Spanish-American War, in May 1898, Torney was ordered to equip and command the United States Army hospital ship *Relief*, and, under his direction, transportation of the sick and wounded from Cuba and Porto Rico to the United States was accomplished in the most efficient way. When the Mexican mobilization took place, the medical equipment of the maneuver division included a complete modern sanitary organization, with full quota of field hospitals and ambulance companies in addition to the regimental sanitary service. General Torney also advocated the bills which reorganized the Dental Corps of the Army and the Army Nurse Corps. At the

time of the San Francisco earthquake and fire, General Torney was commanding officer of the General Hospital at the Presidio, and upon him devolved the general management of medical relief and sanitation in connection with the disaster. Of his splendid work on this trying occasion, the *San Francisco Examiner* says:

By the provisions of General Orders No. 37, General Funston performed, perhaps, the most important act of his administration of the affairs of the city of San Francisco; for by this order he placed the sanitary affairs of the city under the one officer of the United States Army who is the most competent to care for the greatest problem now confronting its courageous citizens. As commanding officer of the General Hospital at the Presidio, Colonel George H. Torney has already made a name for himself which will always live in the memory of San Francisco. Who will ever forget the work he has done for humanity at that magnificent institution? When every other hospital in the city was threatened with destruction and patients were being carried out as fast as willing hands could care for them, Colonel Torney was receiving them at the General Hospital, as fast as automobiles, carriages, wagons and ambulances could carry them to the Presidio. He was one of the first to realize the magnitude of the calamity and without waiting for orders from any one, he notified the city authorities that the General Hospital was at the disposal of its wounded and dying. It is indeed refreshing to see an officer act so quickly and courageously without the usual amount of red tape.

William Crawford Gorgas (1854— ), of Mobile, Alabama, Surgeon General since January 16, 1914, was chief sanitary officer of Havana during 1898–1902, and chief sanitary officer of the Panama Canal from March 1, 1904. His brilliant work in ridding Havana and the isthmus of yellow fever and other dangerous infections will be considered below.

It now remains to describe the scientific work done by individual medical officers of the army, apart from the Surgeon Generalcy.

Before the days of Reed and Gorgas, perhaps the most distinguished name of the Medical Corps in the annals of science is that of William Beaumont (1785–1853), who was the pioneer of experimental physiology in this country and who made the most important contribution to the physiology of digestion for centuries. In June, 1822, Surgeon Beaumont, then stationed at the distant outpost of Fort Mackinac, Michigan, came in contact with a young French Canadian, Alexis Saint Martin, who had sustained a severe accidental gunshot wound of the chest and abdomen. Under Beaumont's treatment the wound was partially healed at the end of about ten months, with the exception of a permanent opening in the stomach or gastric fistula. As Saint Martin was declared a "common pauper" by the civil authorities of the county, Beaumont took care of him in his own house, dressing his wounds daily for nearly two years, and during this time, he became impressed with the fact that the permanent gastric fistula of his patient could be utilized for physiological experimentation. In May, 1825, he began his experiments, a long series of patient researches covering eight years, and although Saint Martin frequently deserted him, and had to be

tracked and brought to the different army posts at Beaumont's own expense, on one occasion nearly two thousand miles, his perseverance was rewarded when he published his "Experiments and Observations on the Gastric Juice, and the Physiology of Digestion" (Plattsburgh, N. Y., 1833), which soon became recognized as one of the great classics of physiology. Beaumont was the first to describe the movements of the stomach, the secretion of its juices and the phenomena of gastric inflammation, as seen by the naked eye, his results anticipating much modern work; and he made studies of the effect of the gastric juice upon different foods which are the foundation of modern dietetic scales. Of his work, Sir William Osler said, in an address made at St. Louis on October 4, 1902:

You do well, citizens of St. Louis and members of our profession, to cherish the memory of William Beaumont. Alive you honored and rewarded him, and there is no reproach against you of merit neglected and talents unrecognized. The profession of the northern part of the state of Michigan has honored itself in erecting a monument to his memory, near the scene of his disinterested labors in the cause of humanity and science. His name is linked with one of your educational institutions, and joined with that of a distinguished laborer in another field of practise. But he has a far higher honor than any you can give him here—the honor that can only come when the man and the opportunity meet and match. Beaumont is the pioneer physiologist of this country, the first to make an important and enduring contribution to this science. His work remains a model of patient, persevering investigation, experiment and research, and the highest praise we can give him is to say that he lived up to and fulfilled the ideals with which he set out and which he expressed when he said: "Truth, like beauty, when 'unadorned, is adorned the most,' and, in prosecuting these experiments and inquiries, I believe I have been guided by its light."

During Surgeon General Barnes's administration, following the Civil War, his medical staff consisted of a brilliant group of officers who did some remarkable scientific work. Of these, Joseph Janvier Woodward (1833-84) was an expert pathologist, and the best worker of his time in photo-micrography, or the photographic enlargement of pictures of microscopic objects, in which he was a pioneer. In this work he was assisted by Edward Curtis (1838- ), who, in 1869, collaborated with Billings in investigating the supposed microscopic organisms causing diseases of cattle. General Alfred A. Woodhull (1837- ) was the first in this country to employ the British Indian method of giving large doses of ipecac in dysentery (1875-6), catalogued the specimens in the surgical section of the Army Medical Museum (1866), and has written valuable manuals on litter drill for Hospital Corps men (1899) and military hygiene for officers of the line (1898). He also made an important report on the Medical Department of the British Army in 1891, and is the author of suggestive studies on the causation of yellow fever (1877-80) and the sanitary relations of military sites (1894). George A. Otis (1830-81) collaborated with Woodward, Charles Smart

and David L. Huntington in the Medical and Surgical History of the War, of which his surgical reports on amputations at the hip joint (1867) and excisions of the head of the femur for gunshot injury (1869) won the admiration of army surgeons all over the world. The most remarkable member of the group was John Shaw Billings (1838-1913), who, during the war, was the first surgeon in this country to attempt the rare operation of excision of the ankle joint (January 6, 1862), with complete recovery of his patient. To his enterprise, perseverance and ability was due the building up of the Surgeon General's Library, which is now the second largest, and through its unrivaled collection of periodicals, the best medical library for actual use in the world. The Index Catalogue of this library, begun by Billings in 1880, with the assistance of his faithful coadjutor, Dr. Robert Fletcher, and continued to date, places the entire literature of medicine, including the contents of periodicals, at the physician's ready disposal, and is used by scientific workers and libraries everywhere. In many important respects it is the most important and extensive bibliography in existence, the first and second series now numbering thirty-seven large quarto volumes (1880-1916). The first volume of a third series (1917) is already in process of publication. Billings was also the designer of the Johns Hopkins and other modern hospitals, supervised the vital and medical statistics of the tenth, eleventh and twelfth censuses, was the leading American authority in his day on military medicine, public hygiene and sanitary engineering, and wrote what is regarded as the best history of surgery in the English language. Upon his retirement from active service in the army, he planned and organized the New York Public Library and its many branch establishments. The many other achievements of this tireless worker would fill a volume.

Dr. Robert Fletcher (1823-1912), after an honorable career in the Civil War as army surgeon, became Dr. Billings's associate in the Surgeon General's Library, edited the *Index Medicus* (1879-1911), was author of the treatise on anthropometry in the statistical volumes of the Provost Marshall's Bureau (1875), of a valuable monograph on "Prehistoric Trephining" (1882), and made many original contributions to anthropology and medical folk-lore.

Dr. H. C. Yarrow, who was surgeon of the Fifth Pennsylvania Cavalry during the Civil War, was acting assistant surgeon in the United States Army for thirty years, during which time he served on exploring expeditions and in the Surgeon General's Library, and made worthy contributions to herpetology, ichthyology and anthropology, notably an extensive study of the mortuary customs of the North American Indians (1880-81).

Jonathan Lettermann (1824-72), of Canonsburg, Pa., was Medical Director of the Army of the Potomac (1862-3), and during this period, brought order out of chaos by his wonderful reorganization of the med-

ical service in the field. He devised a new ambulance system for evacuating the wounded from the field, perfected the present system of supplying the army with medicines and medical material, inaugurated the system of field hospitals for the immediate relief of the wounded and their speedy return to the firing line, improved the blank forms for medico-military reports and did much to combat camp diseases. His record has only been equalled in the past by that of the immortal Larrey, of Napoleon's army.<sup>4</sup>

In accordance with the liberal policies of General Sternberg's administration, Major Walter Reed (1851-1902) was sent to pursue advanced studies in pathology and bacteriology under Professor Welch at the Johns Hopkins Hospital, and in Welch's laboratory made an important investigation of the lymphoid nodules of the liver in typhoid fever (1895). In 1900, Reed was detailed as the head of a board, which included James Carroll, Aristide Agramonte and Jesse W. Lazear, to study yellow fever in Cuba. At this time, it was commonly supposed that the disease was caused by a special micro-organism, the *Bacillus icteroides* of Sanarelli. Reed subjected this theory of causation to severe tests and soon disproved it. Meanwhile, it had been assumed by J. C. Nott in 1848 and by Carlos Finlay in 1881-6 that mosquitoes are agents in the transmission of yellow fever, and this theory had already been proved to be true in the case of malarial fever by the experimental demonstrations of Ross and others. Reed now proceeded to put this theory to the test, and, with his associates, was able to demonstrate in the most rigorous manner, that yellow fever is transmitted by a special variety of mosquito, the *Stegomyia fasciata*, and not as had hitherto been supposed, by contagion from clothing and bedding or through infection by water, sewage, or other substances accidentally taken into the mouth. To prove this, a number of non-immune persons voluntarily subjected themselves to the bites of mosquitoes which had fed upon known yellow fever patients, or to injections of blood or filtered blood-serum from such patients. Twenty-two cases of experimental yellow fever were thus produced, while seven enlisted men boldly slept in infected bedding without acquiring the disease. Carroll was the first to submit to mosquito inoculation, and sustained an attack of yellow fever from which he recovered. Lazear, who had been accidentally bitten by a yellow fever mosquito, died from the disease. Reed's results were soon confirmed by other observers in Mexico, South America and elsewhere, and the fact that yellow fever is transmitted by a special variety of mosquito alone gave the sanitarian the proper means for pre-

<sup>4</sup> For Lettermann's work, see his "Recollections of the Army of the Potomac" (New York, 1866); also *Jour. Mil. Service Inst.*, Governor's Island, N. Y. H., 1883, IV., 250-287 (B. A. Clements); *Military Surgeon*, Chicago, 1913, XXXII., 221-249 (L. C. Duncan); *Johns Hopkins Hosp. Bull.*, Balt., 1916, XXVII., 243-247 (J. T. Smith).

venting its occurrence. Of this discovery Professor Welch said: "I am in a position to know that the credit for the original ideas embodied in this work belongs wholly to Major Reed." General Wood, who had furnished Reed with the authority and the financial means to carry on his experiments, said:

I know of no other man on this side of the world who has done so much for humanity as Dr. Reed. His discovery results in the saving of more lives annually than were lost in the Cuban War, and saves the commercial interests of the world a greater financial loss each year than the cost of the Cuban War. He came to Cuba at a time when one third of the officers of my staff died of yellow fever, and we were discouraged at the failure of our efforts to control the disease. In the months when the disease was ordinarily worst the disease was checked and driven from Havana. That was the first time in nearly two hundred years that the city had been rid of it. The value of his discovery can not be appreciated by persons who are not familiar with tropical countries. Hereafter it will never be possible for yellow fever to gain such headway that quarantine will exist from the mouth of the Potomac to the mouth of the Rio Grande. Future generations will appreciate fully the value of Dr. Reed's services.

President Eliot, in conferring an honorary degree upon Reed at Harvard, expressed himself in the same terms.

The task of eradicating yellow fever at Havana fell to Major William C. Gorgas, who became chief sanitary officer of the city in February, 1901, and who put Reed's hypothesis to practical use by the simple process of screening yellow fever patients and habitations, and by destroying the mosquitoes themselves. Inside of three months, Havana was freed from the disease for the first time in 150 years. On March 1, 1904, Colonel Gorgas became chief sanitary officer of the Panama Canal and on March 4, 1907, a member of the Isthmian Canal Commission. When the French began to work on the canal in 1880, Panama was one of the plague spots of the universe. Colonel Gorgas proceeded to take measures for the sanitation of the isthmus on the widest scale, as it was necessary to make the isthmus free from disease before commencing operations upon the canal. The towns of Colon and Panama were in the poorest sanitary condition, with no proper water supply, drainage or sewage systems, unpaved streets without proper gutters, houses sometimes surrounded by water at high tide, infested with rats, the transmitters of bubonic plague, and, in the outlying country, mangrove swamps and areas covered with dense jungle vegetation, underbrush and matted vines, which are a favorite habitat of mosquitoes. Under the French occupation, it was a by-word that every tile laid cost a life. Hand in hand with such prophylactic measures as destroying mosquitoes by spraying with dripping oil upon the surface of still or running bodies of water, making habitations and hospitals mosquito-proof by covering verandas, doorways and windows with woven wire screens, isolating all suspected cases of malarial or yellow fever, administering prophylactic doses of quinine in malarial patients, it was necessary to

clear up and remove all outlying underbrush, a matter of great expense, to pave and gutter every street, to construct mosquito-proof houses, a complete installation for municipal water supply and sewage disposal by piping, to provide every house with modern closets with a pipe-borne sewage system, to fill and obliterate swamps and stagnant pools, to destroy rats as well as unhealthy houses occupied by them, and to disinfect and fumigate the houses contaminated with dangerous diseases. In 1881-9, the French lost 22,189 laborers by death, in other words a death rate of 240 per thousand per year. One station on the old Panama railroad was called Matachin, from the Spanish words *mata*, "killed," and *chin*, "Chinaman," because 1,000 imported Chinamen in houses at this point died off in six months, as also 1,000 negroes from the West Coast of Africa. When the United States took charge of Panama in 1904, the death rate was 40 per 1,000, a yellow fever epidemic raging there from July, 1904, to December, 1905. In less than a year, Gorgas had eradicated it entirely and there has not been a single case since May, 1906. In that year, the admissions to hospitals for malaria were at the rate of 800 per 1,000 workers; by 1913, this rate had been reduced to 76 per 1,000. The death rate from all causes among the workers was about 41 per 1,000; in 1913, it was 8 per 1,000. The general death rate among the total population is now 22-23 per 1,000. The total cost of sanitation has been less than one per cent. of the total appropriation for all purposes. General Gorgas says:

When the canal shall have been finished it can be shown that sanitation cost about \$365,000 per year. For a population of 150,000 this means an expenditure of about one cent *per caput* per day, and this sum is well within the means of any tropical country.

Elsewhere he says:

I do not believe that posterity will consider the commercial and physical success of the Canal the greatest good it has conferred upon mankind. I hope that as time passes our descendants will see that the greatest good the construction of the Canal has brought was the opportunity it gave for demonstrating that the white man could live and work in the tropics, and maintain his health at as high a point as he can, doing the same work, in the temperate zone. That this has been demonstrated none can justly gainsay.

In Trinidad, British Guinea, and in all tropical posesssions now inhabited by the white races, the preventive measures used by Ross at Ismailia and by Gorgas at Panama are beginning to be employed. In December, 1913, Colonel Gorgas, at the invitation of the Chamber of Mines of Johannesburg, South Africa, made a scientific inspection to investigate the cause of the high death rate from pneumonia among the native laborers working in the mines of the Rand, a force of some 200,000 negroes. The death rate was 71.7 per 1,000 in 1903 and 26.84 in 1912. Gorgas made a careful survey of existing conditions, concluding that malarial fever, tuberculosis and miners' phthisis also play

an important part in the high rate of mortality and made a number of valuable suggestions for preventing these diseases, such as increasing the floor space of barrack habitations to about fifty feet, the housing of families in huts, the establishment of a central sanitary bureau, the introduction of proper sewerage and water supply, the destruction of flies and other details.

On returning to the United States to assume the office of Surgeon General, General Gorgas was banqueted in London on March 23, 1914, and received the degree of Doctor of Science at the University of Oxford on the same day. Upon presenting him for the degree, Mr. A. D. Godley, the public orator of the university, said:

Those are most to be honored by us who have increased knowledge and thereby promoted the welfare of the world. Such are many students of medicine: it is a fine thing to have the scientific knowledge which can cure disease; but theirs is a still finer if more dangerous task who can extirpate the causes from which disease springs. It is such men who destroy the seeds of death which are bred in swamps, risking their health and even their lives to serve their fellows. These heroes are a modern realization of the legend of Heracles, the cleanser of foul places and the enemy of evil beasts.

The eminent American whom you see to-day has, like many of his countrymen, fought in the forefront of the battle. His achievements are too numerous for me to relate in detail. Suffice it to say that it is he who cleansed Havana; it is he who put fever and pestilence to flight in the Isthmus of Panama and made possible the long-thwarted construction of the great inter-oceanic waterway; it is he who has recently improved the sanitary conditions of the South African mines. He purified foul air; he waged war on the myriad swarms of death disseminating mosquitoes. The result has been an amelioration of the conditions of human life in plague haunted districts, where once "in silent fear the helpless healer stood," and it is now possible to live in comfort and to work with advantage. There can be no better example of those "whose skill hath served the human lot to raise, and won a name that endless ages praise."

Upon admitting General Gorgas to the degree, the Acting Vice Chancellor, Dr. T. H. Warren, addressed him as: "Preeminently distinguished, sagacious, health-bringing, the modern Machaon of the American Army, whom indeed I should wish to salute not only in Latin prose but also in Greek verse thus:

Hail Router of the Plague of Flies! Hail Isthmian Conqueror true!  
Gorgas, to that wise Goddess dear, the Gorgon death who slew!

In 1916, General Gorgas spent several months in South America in making a preliminary survey, for the Rockefeller Foundation, of existing endemic foci of yellow fever in that continent.

At the close of the Spanish American War, it was found that more than 20,000 cases of typhoid fever had occurred among our troops encamped within the limits of the United States between May and September, 1898. Major Walter Reed was delegated as president of a board consisting of Majors Victor C. Vaughan and Edward O. Shakespeare, United States Volunteers, to investigate the cause and possible

means of prevention of this plague of encamped armies. After a most careful investigation, it was found that every regiment constituting the First, Second, Third, Fourth, Fifth and Seventh Army Corps developed typhoid fever, that more than ninety per cent. of the volunteer regiments developed the disease within eight weeks after going into camp, that typhoid fever is disseminated by the transference of the excretions of an infected individual to the alimentary canals of others, that camp pollution was a more prominent causal agent in this instance than contaminated water supply, and that the disease was mainly disseminated by flies, on the clothing of human carriers, by dust, and by infected bedding and tentage. Wholesale disinfection of excreta and all other possible sources of infection was recommended, also sterilization of water supply, raising of soldiers' beds from the ground, removal of troops from infected sites and proper policing of new sites, liberal spacing between tents and the men inside them and more correct diagnosis of typhoid by army surgeons, only about one half the actual number of typhoid cases being correctly diagnosed in this instance. In this epidemic, the deaths from typhoid were 86.24 of the total deaths, the morbidity from typhoid was 192.65 per 1,000 of mean strength, the mortality was 14.63 per 1,000 mean strength, in a group of soldiers numbering 107,973 men. The investigations of Reed, Vaughan and Shakespeare attracted wide attention and their recommendations became of great use to army surgeons. We may contrast the figures given by Reed with the results obtained by Major Frederick F. Russell during the mobilization of United States troops on the Mexican border in 1912. Prior to this date, preventive inoculation against typhoid by means of a specific vaccine had been made practicable and successful by Chantemesse and Widal in France, Sir Almroth Wright in England, and others, and in 1909, Major Russell began the gigantic experiment of vaccinating the United States Army against typhoid. From a morbidity of 173 cases in 1909, he was able to bring his statistics down to 9 cases of the disease with one fatality in 1912. At present the army is absolutely free from typhoid. During the Mexican mobilization, Russell vaccinated some 20,000 men against typhoid, the only case occurring in camp being that of a non-vaccinated teamster. As typhoid fever has the reputation of destroying more men in war time than the enemies' bullets, the significance of these statistics needs no further elucidation.

During the American occupation of Porto Rico, it was found that smallpox was endemic there, as it has been in all Spanish American countries. It was said that the people thought little more of smallpox than of an attack of prickly heat. In December, 1898, the incidence of the disease assumed such proportions in the island that an epidemic was threatened. In January, 1899, the reports of the post surgeons for

November and December showed that 3,000 cases had been noted in this short period. Thereupon, by order of Governor General Davis, the entire population of the island, including infants under six months of age, was vaccinated under the direction of the Chief Surgeon of the Division, Major John Van R. Hoff. As an experience of six months had shown that all virus from the United States lost its virility on reaching the island, a vaccine farm was established at Coamo Springs, under the successive commands of Major Azel Ames, U.S.V., and Captain F. P. Reynolds, U.S.A. Cattle were abundant, being obtainable at one dollar per head, and with the cooperation of the native physicians and the local alcaldes, the work was soon accomplished. In spite of the difference in language and customs of the people, the constantly recurring rains which frequently made the mountain streams impassable, the lack of hotels and other accommodations in the country villages, no less than 800,000 persons were vaccinated in three working months and by October 1899, there was not a single case of smallpox known to either the military or civil authorities. The total cost of ridding the country of the disease was \$32,000, or about four cents for each person vaccinated. In like manner, Colonel Hoff stamped out leprosy in the island, by segregating the patients in a leper colony.

In 1900, Captain Bailey K. Ashford discovered the presence of hookworm infection in the island, and shortly afterward, it was found to be very prevalent among the rural population of the southern states of this country by Dr. Charles W. Stiles, of the Public Health Service, who found that the American variety of the specific parasite of the disease is a new species. Captain Ashford has devoted himself to the task of stamping out hookworm infection in Porto Rico, having treated some 300,000 patients in 1903-4, and having reduced the mortality by ninety per cent. He is now engaged in the study of the causation of tropical sprue in South America.

In the Philippines, Captain Charles F. Craig demonstrated that intra-corporeal conjugation in the parasites of malarial fever is the cause of latency and relapses of the disease, and that there are malaria carriers, that is persons who carry the malarial parasites about with them without being affected by the disease. In 1906, Craig discovered a new parasite connected with the dysenteric infections, the *Paramæba* (now called *Craigia*) *hominis*, and is the author of valuable monographs on the malarial fevers (1901, 1909) and the parasitic amoebæ in man (1911). With Major Percy M. Ashburn, he discovered another parasite, *Microfilaria philippinensis*, in 1906, and demonstrated that the cause of dengue or break bone fever is a filterable virus transmitted by the mosquito *Culex fatigans* (1907).

In the Philippines also, Captain Edward B. Vedder made important investigations of beri beri, a tropical form of neuritis which has been

attributed to a too exclusive diet of highly milled or polished rice. It was found that the disease is what is now termed a "deficiency disease," that is one caused by a diet deficient in certain substances necessary to the physiological economy of the body. This was conclusively proved by Vedder and his associates, after a careful investigation of the pathology of the disease in fowls as well as man. It was shown that beri beri can be eradicated in the native Philippine troops and scouts by a simple change of ration, substituting under-milled for polished rice, that the disease can be experimentally produced in puppies and fowls, and that the administration of an alcoholic extract of rice polishings to infants suffering from beri beri will alleviate some of the symptoms of the disease. It is recommended that under-milled rice be substituted for the polished variety as a food staple for the poorer classes wherever possible. All these results have been admirably summed up in Captain Vedder's recent treatise on beri beri (1913) which is the latest and most exhaustive work on the subject. Captain Vedder was also the first to determine that emetine has a specific amœbicidal action in amœbic dysentery (1910-11), which fact was speedily translated into action by Sir Leonard Rogers, and others.

When Ehrlich announced the discovery of his new remedy for syphilis ("606"), Captain Henry J. Nichols of the army collaborated with him in trying out the drug in the early stages of its investigation, and shortly after, Surgeon General Torney issued a circular giving directions for its use in the army. Since then, Captain Nichols has continued his valuable researches on the treatment of syphilis and has investigated the experimental production of the tropical disease "yaws" or framboesia (1910-11).

Major Eugene R. Whitmore established the Pasteur Institute at Manila (1910), made investigations of rabies and tropical dysentery, and served on the Yellow Fever Commission (South America) in 1916.

In 1911, Drs. E. R. Gentry and T. L. Ferenbaugh discovered that Malta fever is endemic in Southwestern Texas, in connection with the goat ranches, demonstrating these animals to be the agents of its transmission.

Major Weston P. Chamberlain has made important investigations of hookworm infection, diphtheria, Vincent's angina, typhoid fever and beri beri in the Philippines, and collaborated with Captain Vedder in his work on beri beri.

Lieut. Colonel Charles E. Woodruff (1860-1915), retired, late editor of "American Medicine," made highly original investigations on the deleterious effects of tropical light on the blonde races, and has published several volumes, including "The Effects of Tropical Light on White Men" (1905), "The Expansion of Races" (1909) and "Medical Ethnology" (1915) which have had an international circulation and reputation.

Captain Arthur C. Christie is the author of the latest and most up-to-date book on X-ray diagnosis (1913).

The recent treatise of Colonel Louis A. La Garde on gunshot wounds (1914) is, in connection with the present war, the book of the hour. Colonel La Garde was the first to point out that microorganisms are not destroyed, when placed in gun powder or on projectiles, by the act of firing (1892). Up to the time of his first publication on the subject, the idea had prevailed that the heat of ignition in the explosion and that conveyed to the bullet at the time of firing was sufficient to disinfect both, and that powder grains and bullets were made sterile after leaving the gun. By means of extensive experiments, conducted in the laboratories of the Johns Hopkins Hospital, on inanimate matter and animals, he was able to show that earlier notions of the subject were erroneous, and that both powder and projectile, when primarily infected by virulent organisms, like the bacilli of tetanus or anthrax, and shot into animals at all ranges up to five hundred yards, still carried these organisms, conveying the diseases to susceptible animals struck by them with the usual fatality. These experiments which are fully described in Colonel La Garde's Mütter Lecture on Poisoned Wounds by the Implements of Warfare, delivered before the College of Physicians at Philadelphia in December, 1902, soon prompted surgeons, military and other, to be more thorough in the treatment of gunshot wounds. Such a thing as a sterile gunshot wound is no longer advocated and the greatest care was thereafter taken to rid such wounds of septic matter introduced by the act of firing. These and other writings have given Colonel La Garde a wide reputation as a recognized authority on military surgery. In 1892, he was detailed as the medical member of a board of army officers to determine the best type of rifle and ammunition to be selected in changing the armament of the United States Army. His advice was of great value to the Government in selecting the kind of weapon which has since been in use by our foot and mounted troops.

Col. Jefferson R. Kean as Chief Surgeon of the Cuban Army of Pacification did yeoman service in the prevention of infectious diseases in that island, and is now director of the Red Cross and base hospital establishment.

The manuals of military medicine by Charles S. Tripler (1858), General Alfred A. Woodhull (1898), and Lieut. Colonel Paul F. Straub (1910), also the manual of military hygiene by Colonel Valery Havard (1909) are highly esteemed in the medical corps.

Lieut. Colonel Edward L. Munson, editor of the new *Military Surgeon* (1916), devised the Munson shoe for troops (1912) and has written valuable treatises on military hygiene (1901) and sanitary tactics (1911), the former having been a text-book in the British as well as the American army.

Dr. Joseph Y. Porter, Lt. Col., retired, has made a national reputation as State Health Officer of Florida which office he has conspicuously adorned for many years.

Among those who have made reputations outside the medical sciences are Dr. Elliot Coues, deceased, Major James C. Merrill, deceased, Captain Robert W. Shufeldt, retired, who have international renown as ornithologists, Lt. Col. Edgar A. Mearns, deceased, who accompanied Colonel Roosevelt to Africa, and was one of the leading ornithologists of the world; and Major Washington Matthews, deceased, who made important contributions to the science of anthropology, particularly to the folk-lore of the Navaho Indians. Major James Evelyn Pilcher (1857-1911), editor of the *Military Surgeon* (1907), wrote a valuable series of biographical memoirs of the Surgeons General of the Army (1905).

The administrative successors of Colonel Billings as Librarians of the Surgeon General's Office were Lt. Col. David L. Huntington, Major James C. Merrill, Major Walter Reed, whose achievements have already been referred to, Colonel Walter D. McCaw, who created the historical collections in the library, wrote the treatise on "Tropical Surgery" in Keen's Surgery, and is now Chief Surgeon on the Mexican Border, and the present incumbent. Among the recent medical archivists of the army medical establishment, Major Louis C. Duncan has made valuable medico-military studies of the battles of the Civil War (1912-14) and Lieut. Fielding H. Garrison (Medical Reserve Corps), editor of the *Index Medicus*, has contributed extensively to medical bibliography and medical history.

The Army Medical Corps has contributed to the line of the Army Major General Leonard Wood, late Chief of Staff, and to the staff Major General F. C. Ainsworth, late Adjutant General. The work of General Ainsworth in the reorganization of the Record and Pension Office, and of General Wood in Cuba and elsewhere are known to all.

Army surgeons of other nations include such great names as those of John Hunter, Sir Joseph Fayrer, Charles Murchison, Sir Ronald Ross, Sir David Bruce, Sir William B. Leishmann and Sir Leonard Rogers in England, the Langenbecks, the elder von Graefe, Dieffenbach, Stromeier, Helmholtz, Cohnheim, Löffler and von Behring, in Germany, Laveran and Widal in France, and Pirogoff in Russia; and in variety of accomplishment, no doubt the Medical Corps of the United States Army is equalled, if not surpassed, by the work of the Indian Medical Service of Great Britain. But, in preventive medicine, we believe that the scientific achievement of our Medical Corps is unequalled by that of any other army of modern times.